Study on Mechanical Properties of Goat Hair Based Composite

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ABSTRACT

Natural fibers are Low-cost and environment friendly materials with improved mechanical properties. These properties can be enhanced by combining natural fibers in different composition. Two natural composite are fabricated with goat hair & coir as fiber and epoxy as matrix. In the process of composite making, three layers of fiber are sandwiched together using epoxy resin. Compression moulding method is being followed to distribute uniform pressure on sandwiched layers. In first combination composite is made by three layers of goat hair. In second combination composite is made by sandwiching one layer of coir fiber between two goat hair layers. These two composites are tested for mechanical properties. Tensile strength, Flexural strength and Impact strength tests are performed. Study has been done by analyzing the mechanical properties of the two composites and reported.

Keywords: Goat hair, Coir, Epoxy resin,

1. INTRODUCTION

Composite materials are materials made from two or more constituent materials with significantly different physical or chemical properties. They have interfaced to separate continuous and discontinuous phase. The discontinuous phase is usually harder and stronger than the continuous phase and is called the reinforcement, whereas the continuous phase is termed as matrix.

Composites made by natural fibers are termed as natural composites. There is an increase demand for environmental friendly materials such as natural fiber composites to replace the traditional fiber (i.e. carbon, glass, and aramid fiber) composites [1]. The reasons are: biodegradability, less emissions to the atmosphere, abundant, renewable, availability and can be produced at low cost in many parts of the developing world.

Goat hair is a natural fiber extracted from the skin of goat. It is Bio- degradable, Eco- friendly, smooth, soft, elastic, low-cost and is available in plenty [2]. Even though goat hair is used for many other applications not much work has been tried out in using goat hair for making composite. Disposal of goat hair in tannery process [3, 4] is a big headache for them in waste management. With above issues natural composite using goat hair is made and various mechanical tests are performed.

Table.1, Mechanical Properties of Various Fibers [5]

Fibers	Density ,d (gm /cm^3)	Tensile strength (MPa)	Modulus, E (GPa)	Ratio (E/d)
E-glass	2.55	2400	73	29
Hemp	1.48	550 - 900	70	47
Jute	1.46	400 - 800	10-30	7-21
Ramie	1.5	500	44	29
Coir	1.25	220	6	5
Sisal	1.33	600 - 700	38	29
Flax	1.4	800 - 1500	60-80	26-46
Cotton	1.51	400	12	8

2.1 GOAT HAIR FIBRE

Goat skin is purchased from meat shop and then it is allowed to decompose in open air for 30 hours. Hair fibers are pulled out from skin and are washed thoroughly many times. These fibers are allowed to dry at the absence of sunlight. Dried fibers are again washed with acetone [6] and warm water. These fibers are allowed to dry at presence of sunlight. Dried goat hair is manually separated and inspected for presence of foreign particles. Sample of hair is tested individually.

Table.2, Properties of Goat Hair

Length	42-118 mm
Diameter	76-107 microns
Moisture absorption	7.62 %
Elongation in shear	9.54-30.69 %

Fig.1, Goat hair in plate form

This is a natural fiber extracted from coconut. Coir is used to make ropes, mats and other house-hold items. [7]. It has good insulating property, damping property and comfortable mechanical properties [8]. It is of 12 to 24 microns in diameter [2]. It is a low-cost natural fiber and available in plenty in nature. It is purchased from the shop.

2.3 MATRIX

The most normally utilized thermosetting resins are epoxy (ultimate strength 12-30 Mpa) [9], polyester, vinyl ester, polyurethanes and phenolic. Among these epoxy resin is the most widely used material due to prevalent mechanical and thermal properties even at high temperatures and low shrinkage after curing and great synthetic safety. Epoxy is used as matrix material for making composite [2, 10].

3. PROCEDURE OF COMPOSITE FABRICATION

3.1 COMPOSITE 1

10 grams of hair fiber is taken and arranged in 180mm x180mm square plate form with all the hair fibers in same direction. In that manner 3 plates are made. Epoxy matrix is applied over one plate. Second plate of fiber is kept over it at perpendicular direction to the fur of first plate. Again epoxy matrix is applied over it and third plate is kept over it at perpendicular direction to the fur of second plate. All these plates sticking together had undergone compression moulding. The composite is allowed under compression for 48 hours. The weight of composite after 48 hours compression is 60 grams. After compression the composite is sent for mechanical testing.

3.2 COMPOSITE 2

In this process coir layer is sandwiched in between goat hair layers. Coir layer weight is 10 grams. Epoxy matrix is applied on every layer and mutually perpendicular direction is followed at arrangement. Compression moulding is done for 48 hours. After compression moulding weight of composite is 60 grams. Mechanical tests are performed on it after compression.

4. RESULTS AND DISCUSSION

4.1 TENSILE TEST

Ultimate tensile strength or tensile strength is the maximum stress that a material can withstand while being stretched or pulled before breaking [11, 12]. Tensile testing, also known as tension testing is a fundamental materials science test in which a sample is subjected to a controlled tension until failure [13].

Fig.2, Tensile strength testing machine

Fig.3, Composite of Goat hair for Tensile testing

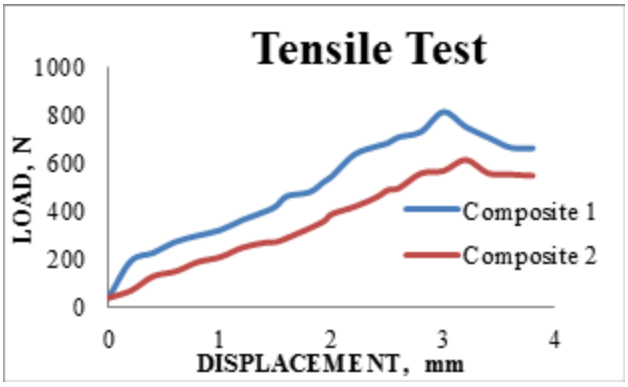
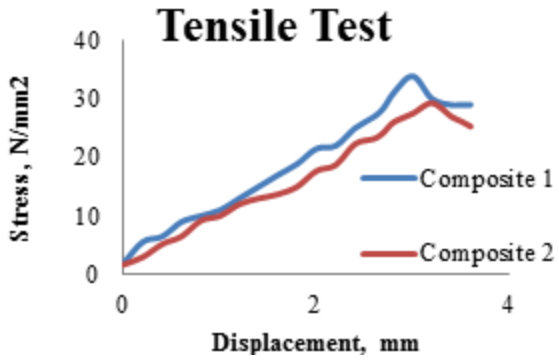


Fig. 4, Load vs. Displacement of composites



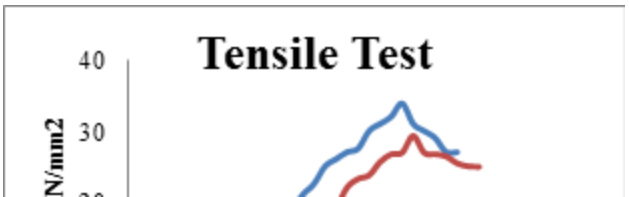


Fig.6, Stress vs. Strain of Composite

Table 4.1 Tensile strength of composites

Composite No	Tensile Strength (Mpa)
composite 1	33.9
composite 2	29.3

4.2 IMPACT TEST

The charpy impact test, carried out as per ASTM D256 test standard, also known as the charpy v-notch test, is a standardized high strain rate test which determines the amount of energy absorbed by a material during fracture [14]. Notch of composite is shown in Fig. 7. This absorbed energy is a measure of composite materials notch toughness and acts as a tool to study temperature-dependent ductile-brittle transition. The notch in the sample affects the results of the impact test [15]. This test is done to determine the ductility of the materials [16]. Composites have undergone the impact test. Impact strength is measured. Result of impact test is tabulated at table 3.

Fig.7, Composite of Goat hair for Impact testing

Table.3, Impact Test Result

Composite No	Impact Strength (joules)
Composite 1	0.72
Composite 2	0.43

4.3 FLEXURAL TEST

Flexural strength, also known as modulus of rupture, bend strength, or fracture strength, a mechanical parameter for brittle material [17], is defined as a material's ability to resist deformation under load [18, 19] is conducted as per ASTM D790 test standard. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until fracture level. This fracture level is realized using a three point contact technique [20]. Composite strip of goat hair that has undergone flexural testing is shown in fig. 8. Flexural test of composite is done on 3 point testing machine (fig. 9).

Fig.8, Composite of Goat hair for Flexural testing

Fig.9, Flexural Testing machine

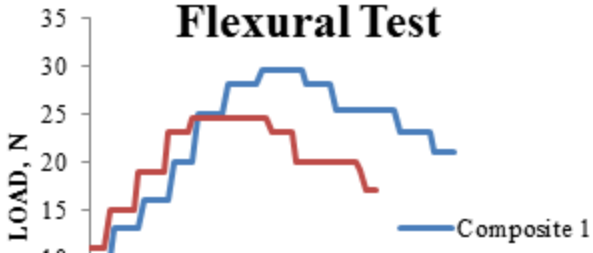


Fig.10, Load vs. Displacement of Composite

Table.4, Flexural Test Result

Composite No	Flexural Strength (Mpa)
composite 1	2
composite 2	1

5. CONCLUSION AND FUTURE WORKS

Tensile, Impact and Flexural tests are conducted on goat hair composite. Data are analyzed and compared. Composite 1 has better tensile strength, improved impact strength and elevated flexural strength compared to composite 2.

Mechanical properties can be enhanced with varying the composition of fibers and resin. Other tests like thermal, absorption, adhesive, laminar, compressive etc. can be done on it in future in order to utilize the application of Goat hair composite.

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